SAFIR®: a software for modeling structures in fire

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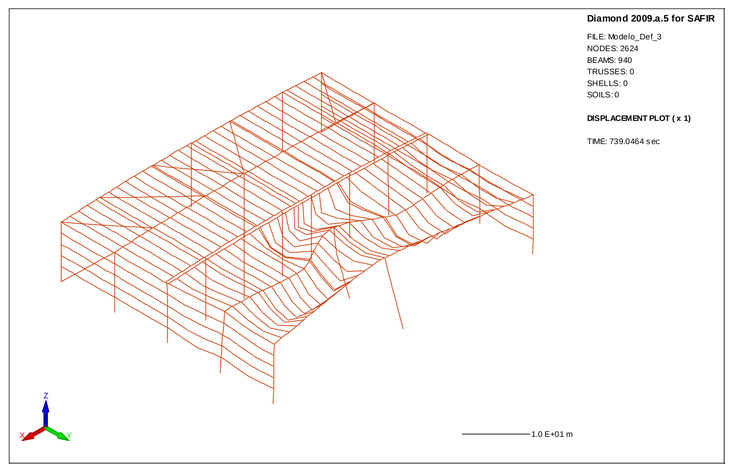
1. Description of SAFIR

SAFIR is a computer program developed at University of Liege to model the behavior of **building structures** subjected to **fire**.

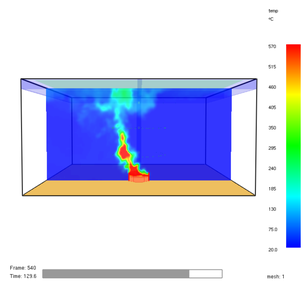
The structure can be made of a 3D skeleton of linear elements such as **beams** and **columns**, in conjunction with planar elements such as **slabs** and **walls** and **volumetric** elements. Different materials such as **steel**, **concrete**, **timber**, **aluminum**, **gypsum** or thermally insulating products can be used separately or in combination in the model.



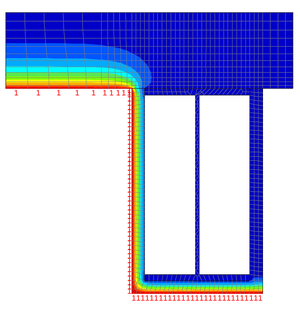
Flumilog test, INERIS, France

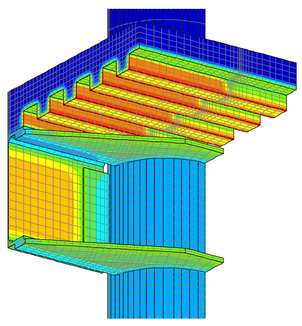
2. Fire-Structure Interaction

The structural fire analysis works in 3 steps:

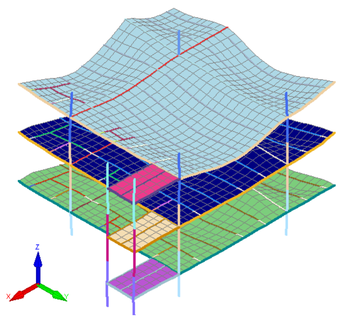


1. The **thermal attack** from the fire is given as an **input** data
   - ✓ ISO fire or user-defined
   - ✓ Localized fire
   - ✓ Coupling with CFD





2. **SAFIR** computes the **evolution of temperature** in the sections
   - ✓ 2D or 3D
   - ✓ Predefined materials or user-defined



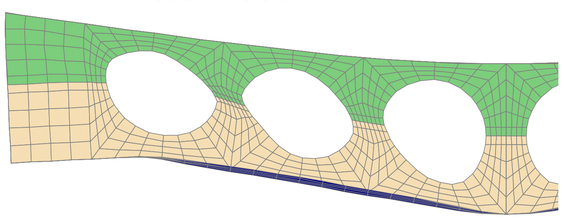
3. **SAFIR** computes the **mechanical response** of the heated structure
   - ✓ 2D or 3D
   - ✓ FE: truss, beam, shell, spring, solid
   - ✓ Non linear

The software captures the effect of fire on structures:

- ✓ Automatic coupling between thermal and mechanical analysis
- ✓ Degradation of material properties with temperature
- ✓ Thermal elongation and second-order effects (large displacements)

It has been validated against tests in numerous research projects

Web post buckling of a cellular steel beam in fire



3. Users in the World

>120 academic users
>90 commercial users

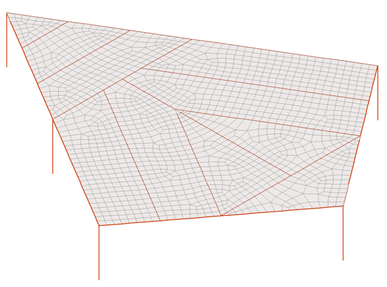
Free demo version

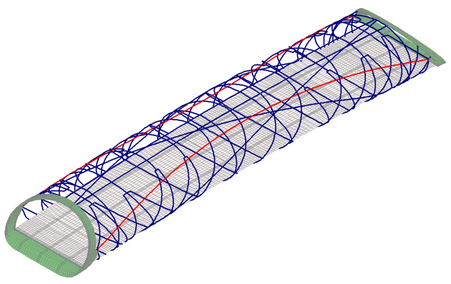
Training sessions

SAFIR has been used to design iconic structures

Japan Tobacco headquarter (INGENI)

Wilsdorf bridge (MP Ingénieurs Conseils)





4. References

Franssen, J.M., Gernay, T. (2017), Modeling structures in fire with SAFIR®: Theoretical background and capabilities, *JSFE*, 8(3).

Franssen, J.M. (2005), “SAFIR: A thermal-structural program for modelling structures under fire”, *Engineering Journal*, 143–158.

SAFIR website http://www.uee.ulg.ac.be/cms/c_2383458/en/safir
Online orders http://www.gesval.be/fr/catalogue/safir-2016-commercial

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